

Space Weather Technical Forecast

Issued on Sunday, 06 February 2022 at 13:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of M-class flares (R1/R2 Radio Blackouts) throughout. Reducing Chance of isolated G1/Minor Storm activity. Active electron fluence expected throughout the period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: There are five active regions on the visible disc, with ex-AR2936, a large and active region in the northwest quadrant rotating across the western limb. There are two further large regions in the northern hemisphere, AR2940 (Eai/Beta) which appears stable and AR2941 (Eki/Beta) which has undergone some evolution to a higher flare risk region through the last 24 hours. Only C-class flare activity has been observed, with the majority of these emanating from AR2941 and the now ex-AR2936. No Earth directed CMEs have been observed on available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, has been elevated at around 550km/s, but with a brief enhancement to 630km/s between 06/0830UTC to 0930UTC. Density has been around average with a brief increase to 22ppcc at 06/0925UTC. Interplanetary magnetic field strength has been weak, with the north-south component, Bz also varying weakly. Phi angle was predominantly negative (towards the Sun) with a brief rotation into the positive direction between 06/0830UTC and 06/0930UTC. The enhancements between 06/0830UTC and 06/0930UTC appear to be due to a brief solar sector boundary crossing. Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at background levels. The high energy electron flux has been mainly at high levels, with only a brief decline, peaking at 2.77e3pfu at 05/1800UTC. Electron fluence values started at moderate levels, reaching 8.99e7 integrated pfu at 06/0000UTC, but have increased above the Active (1e8 integrated pfu) threshold, finishing the period at 1.22e8 integrated pfu.

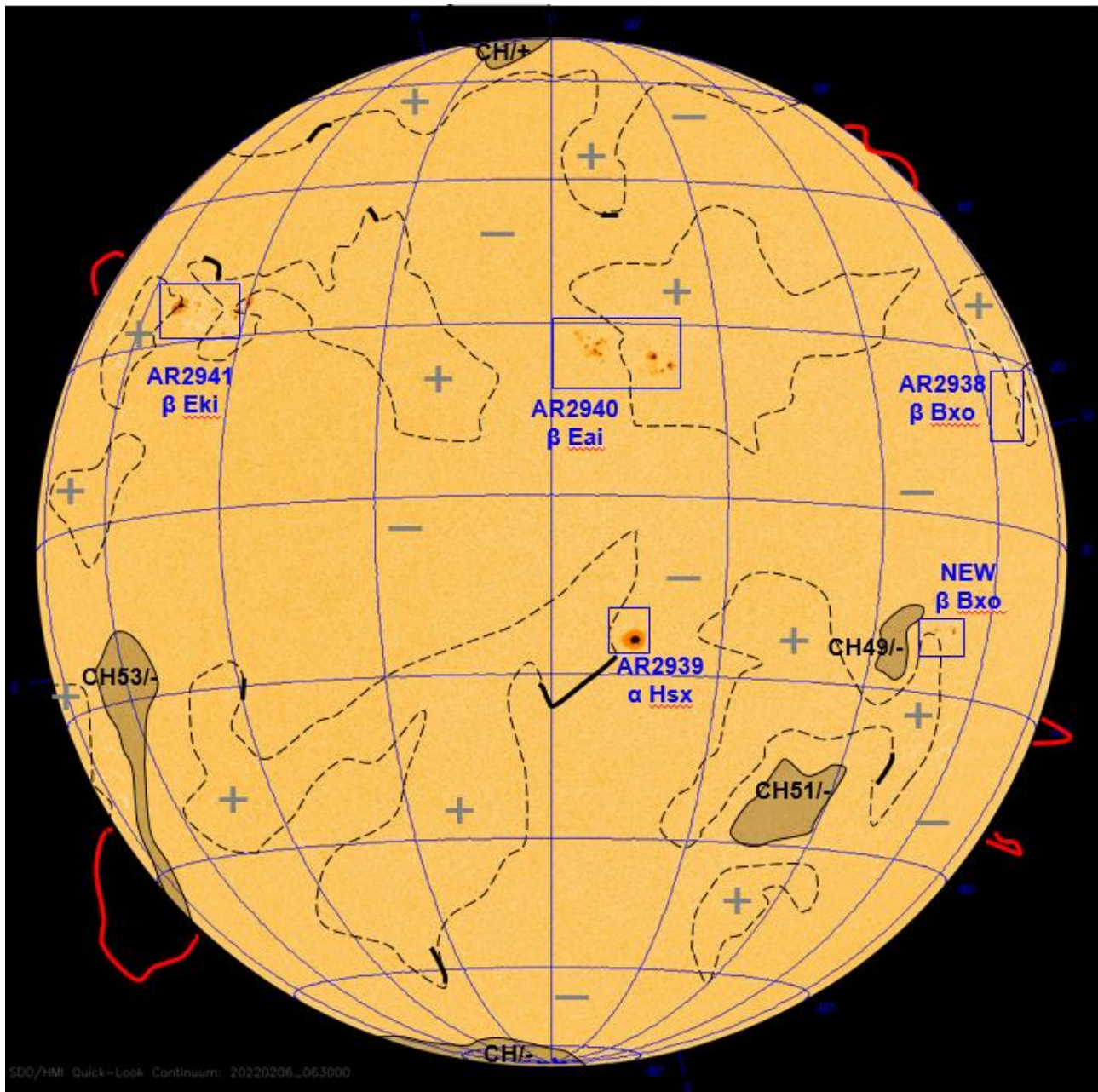
Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be very low, with the two large regions in the northern hemisphere likely to be the most significant source of flare activity.

Solar Wind / Geomagnetic Activity: Solar winds wind speeds are expected to average around 550km/s through days 1 to 3 (06 to 08 February). This is due to the high speed stream from coronal hole 49 and the expected connection with coronal hole 51 later on 06 February. No Earth-directed CMEs are forecast. Geomagnetic activity is expected to be mainly Quiet to Unsettled through much of the period, with a slight chance of Active or G1/Minor Storm intervals due to the potential connection with the high speed stream from coronal hole 51, then due to any sustained periods of Bz in the elevated high speed stream. Solar wind speeds and geomagnetic activity are then expected to begin a decline through days 3 and 4.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is forecast to be at background to moderate levels but with a slight chance of rising close to or just above the S1 level given any significant M-class flaring. High energy electron flux (greater than 2MeV) is expected to continue through much of the forecast period. Electron fluence is also expected to remain above the Active ($1e8$ integrated pfu) threshold.

Figure 1. Solar Analysis Valid 06/0800UTC.



Key: Filament ___, Prominence ___, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.



Geomagnetic Storms:

The high speed stream from coronal hole 49 is currently connected to Earth with speeds of 550km/s. This is expected to slowly weaken through day 4. A concurrent high speed stream from coronal hole 51 is expected to connect with the Earth later on 06 February, with similar speeds. No further high speed streams are then due to connect with the Earth. No Earth-directed CMEs are forecast.

Geomagnetic activity is forecast to be mainly Quiet to Unsettled, with a slight chance of Active or G1/Minor Storms on day 1 due to the onset of the high speed stream. A very slight chance of G1/Minor Storms is then maintained on days 2 and 3, due to the risk of enhancements in any sustained periods of negative Bz.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	20	10	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

None expected

Figure 2: Recent solar wind parameters at L1



Radio Blackouts - X-Ray Flares:

The most notable regions of the visible disc are AR2940 (Eai/Beta) near to the centre disc and AR2941 (Eki/Beta) in the northeast quadrant. AR2941 has evolved most significantly over the last 24 hours, especially in the trailer spot. Ex-AR2936 has rotated over the western limb, but a risk of flaring remains for this region, should any flares rise above the limb. The remaining regions appear to be benign and stable.

Solar activity is expected to remain mainly low for the next 4 days, with a slight chance of M-class flares and a very slight chance of X-class flaring. Both AR2940 and AR2941 are expected to persist on the disc over the next four days, leading to a consistent flare risk through the period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 3: GOES 16 X-ray flares

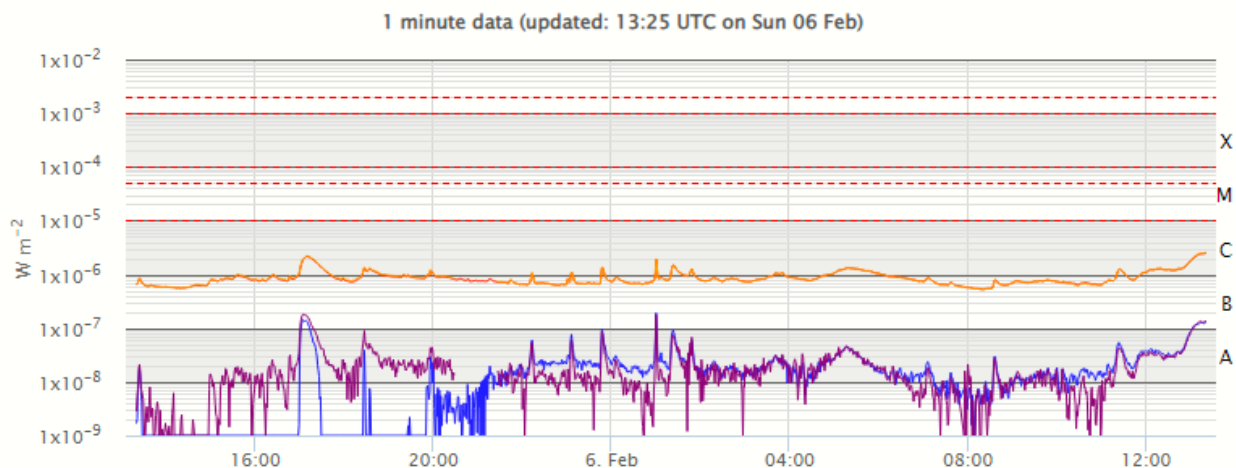
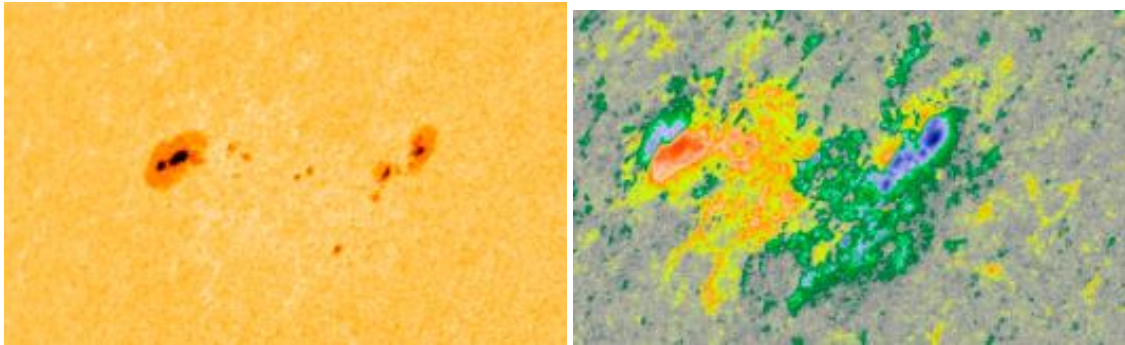


Figure 4 HMI intensitygram and magnetogram imagery of AR2941



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux, as measured by GOES-16 is at background levels. Solar radiation storms are not likely in the period, however there is a very slight chance for proton fluxes to rise given any significant flaring.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	2	2	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm ⁻² sr ⁻¹ s ⁻¹)						

High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux (greater than 2MeV) is at high ($1\text{e}3\text{pfu}$) levels and is expected to remain at this level through much of the next 4 days. There may be brief drops to moderate or background levels due to geomagnetic enhancements, but due to the current level of the high speed stream and electrons in the belts, any redistribution is likely to be limited. Mainly high levels are expected through days 1 to 3 (06 to 08 February), with limited decline from later day 3 as the high speed streams begin to ease.

Electron fluence values are expected to remain around the Active ($1\text{e}8$ integrated pfu) threshold through the next 4 days, in view of the relatively benign radiation belt conditions.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1\text{e}8$	No	100	90	90	80
Very Active	$\geq 2\text{ MeV}$ $\geq 1\text{e}9$	No	1	5	5	5

Figure 5: MOSWOC REFM electron fluence model and observations

